REMARKS

The undersigned thanks the Examiner for the courtesies extended during the interview of May 14, 2003.

Based on the previous Amendment, the Examiner withdrew the 102 rejection. The Examiner still continued to maintain the obviousness rejection of claims 1-5, 7-9, 11-16 and 18-20 over Bian and Ohkubo. This rejection is respectfully traversed.

Bian discloses a seedlayer thickness of about 5 nm as the lower limit while the pending claims recite a seedlayer thickness of about 40Å as the upper limit. The Examiner's position is that about 5 nm overlaps about 40Å. During the telephone interview, the undersigned suggested that the proper way to determine whether about 5 nm overlaps about 40Å is to determine what a person of ordinary skill in this art would consider the meaning of "about" would be for the sputtering process used in the industry. The Examiner agreed.

Subsequently, the undersigned held a conference call between the Examiner, Dr. Li-Lien Lee, the first named inventor and the undersigned. Dr. Lee said said that he worked at Intervac, which makes the sputtering equipment used for deposition of the layers of a magnetic recording medium, before joining Seagate and he knows that the accuracy of deposition by a sputtering process is about 4-6%. Thus "about 40Å" means up to 43Å at the most and "about 5 nm" means up to 47Å at the least. Dr. Lee also said that manuals of the sputtering machines have this 4-6% sputtering accuracy information and he will provide this information for the record. The Examiner said that if he does so, then the claims would be allowed.

Attached find a copy of the Acceptance Test Procedure (ATP) for MDP-250B sputtering machine manufactured by Intervac. The MDP-250B unit is a disk sputtering system widely used for manufacturing magnetic disks for hard drives.

On page 16 of the ATP document, it is stated that the thickness uniformity of a Cr film (a typical non-magnetic film) sputtered by a CM station and a RM station are less than ± 6% and ± 4%, respectively. The CM station is an older type of station as compared to the RM station. Note that the ATP document is dated June 4, 1998, which is prior to the filing date of the priority application from which is application claims benefit. Thus at the time of this invention, persons of ordinary skill would have recognized that "about 40Å" means up to 43Å, but not more, and "about 5 nm" means up to 47Å, but not less. Thus there is no overlap between about 5 nm of Bian and about 40Å recited in the claims.

In light of this Amendment, a Notice of Allowance is respectfully solicited.

In the event that the transmittal letter is separated from this document and the Patent and Trademark Office determines that an extension and/or other relief is required, applicant petitions for any required relief including extensions of time and authorizes the Commissioner to charge the cost of such petitions and/or other fees due in connection with the filing of this document to **Deposit Account No. 03-1952,** referencing docket number 146712002600.

Respectfully submitted,

Dated: June 4, 2003

By: ______________________

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Backed up on diskette:____
and file server:____
Date:________________

APPROVAL		DATE
Engineering Mgr		
Marketing Mgr		

MDP-250B FINAL ACCEPTANCE TEST PROCEDURE

D/N 711338D
June 4, 1998

Vacuum Systems Division
INTEVAC, INC.
3550 Bassett Street
Santa Clara, CA 95054
(408) 986-9888

1.0 SCOPE

This procedure describes the final acceptance tests for the MDP-250B Disk Sputtering System and sets the criteria for performance and acceptance. Attendance at testing is at the customer's option.

This procedure contains the following sections:

- 2.0 Reference Documentation
- 3.0 General Test Procedure
- 4.0 Vacuum System Testing
- 5.0 Disk Transport and Process Conditions
- 6.0 Testing of Disk Transport and Process Systems
- 7.0 Other

Cycle Count:	Hours:
Serial Number:	Sales Order Number:

2.0 REFERENCE DOCUMENTATION

Prior to final acceptance testing, the MDP-250B will have undergone setup, calibration, and preliminary testing. The following documents describe those preparatory procedures:

702601	*MDP-250B Calibration and Preliminary Test Procedure*
700207	*MDP-250 DC Control Card Test Procedure*
702639	*CM-Gun DC Source Station Test Procedure*
702640	*IR Power Supply (12kW) Calibration Procedure*
702641	*IR Heater (12kW) Control Assembly Test Procedure*
707881	RM-Gun Option Manual

3.0 GENERAL TEST PROCEDURE

This document describes final acceptance tests which must be performed on the MDP-250B Disk Sputtering System (hereafter called System) purchased by Storage System Division of NSG Glass Disk Co., Ltd. (hereafter called NSG) and manufactured by VSD of Intevac, Inc. USA (hereafter called Intevac).

Final acceptance tests will be performed at Intevac in the presence of one or more representatives from NSG and the engineering department at Intevac.

The System will be dismantled and packaged for delivery to NSG only after tests are approved by authorized representatives of NSG and Intevac and all of the items tested meet the specified values and/or conditions of the contract.

Should any fault appear or issue arise during final acceptance testing, concerned individuals from NSG and Intevac and Intevac's authorized representatives will consult about the fault or issue and mutually determine whether final acceptance tests will be continued and how to resolve the issue. If it is decided to continue final acceptance tests successively, actions to be taken and the time allowed to complete them will be mutually agreed to in writing.

If malfunction of the transport system, sensors, or software occur during testing, the malfunction will be corrected and the test will be started again from the beginning. In any case, the problem to be resolved and the period of time allowed for corrections will be fully defined in writing.

It is agreed that any faults or issues arising during final acceptance testing at Intevac shall be basically settled and corrected either during the factory acceptance test procedure or while the System is being installed at NSG.

If it appears that delivery may be delayed because a problem cannot be quickly corrected, representatives of NSG and Intevac will consult and mutually resolve the issues of delivery postponement, time allowed for problem correction, and restart of final acceptance testing. Agreements will be specified in writing.

Test results will be given to NSG by Intevac during final acceptance testing. Certain tests specified in Section 7.0 will be repeated during the installation at NSG.

Intevac will collect technical data specified in the acceptance procedure and make deposition tests.

4.0 PRE-ATP SYSTEM EVALUATION

The following tests and data gathering will be performed prior to factory ATP. These activities are intended as data collection only. Intevac does not warranty, guarantee, or imply any operational specifications for system performance based on the collection of this data.

Note: The following sections are for data collection only.

4.1 Mass Flow Controllers Response Time

1. Using a data storage scope or equivalent, measure *Flow vs. Time* characteristics for one MFC on each process station (12 MFCs). The following settings shall be used:

Argon Flow	6.7 sccm (~2mT)
Idle Setting	0 sccm
Burst Setting	0 sccm
Process Duration	5.0 seconds

Include on each plot both the MFC output signal (i.e. flow) versus time and the shutoff valve voltage signal versus time. Include all plots (12) in the pre-ATP report.

4.2 Process Chamber Pressure Response Characteristics

1. Using a storage scope or equivalent, measure the Pressure vs. Time characteristics for one CM-gun process station and one RM-gun process station (2 stations). The following settings shall be used:

	CM STATION W/CRYOPUMP	RM STATION W/ TURBOPUMP
Argon Flow	6.7 sccm (-2mT)	6.7 sccm (~2mT)
Idle Setting	2 sccm	2.0 sccm
Burst Setting	0 sccm	0 sccm
Burst Duration	0 seconds	0 second
Process Duration	5.0 seconds	5.0 seconds

Include on each plot both the manometer output signal (i.e. pressure) versus time and the shutoff valve voltage signal versus time. Include all plots (2) in the pre-ATP report.

2. Using a manometer (for pressure) and MFC (for flow), measure and record Argon Pressure vs. Flow characteristics for one CM-gun process station and one RM-gun station as follows:

ARGON FLOW (SCCM)	PRESSURE (MTORR) FOR CM STATION W/CRYOPUMP	PRESSURE (MTORR) FOR RM STATION W/TURBOPUMP
5		
10		
20		
30		
40		

Include above data in pre-ATP report.

4.3 Heater Operational Characteristics.

1. Using a strip chart recorder or tabular data format, record the actual power, current, and voltage for all heater stations at the following set-points.

HEATER SETPOINT (KW)	ACTUAL POWER READING (KW)	CURRENT READING (AMPERES)	VOLTAGE READ-ING (VOLTS)
0.5			
1.0			
1.5			
2.0			
2.5			
3.0			
5.0			
9.0			
12.0			

4.4 Process Station Plasma Voltage Characteristics

1. Using a strip recorder connected to the appropriate process station power supply, record the target voltage and power as a function of time (i.e. to measure ramp rate, stability, and extinguish rate). Perform this procedure on three separate stations: RM-gun station with cryopump, CM-gun station with cryopump, and RM-gun station with turbopump (3 data sets). Use the following settings:

Argon Pressure	6.0 mTorr
Process Power	1.0 kW
Process Duration	5.0 seconds

4.5 Carousel Alignment

1. The following data (actual measurements) shall be provided from the final carousel adjustment:
   - Circumferential side-to-side measurements (i.e. S1 and S2)
   - Radial side-to-side measurements
   - Vertical runout
   - Vertical tilt
   - Radial runout

4.6 Carousel Motor Current Measurements

1. Referring to the motor driver for carousel vertical motion, record actual motor current for the Carousel Up position at all pedestal locations (i.e. rotating the carousel through each of 14 positions). In addition, record motor current for one pedestal location with carousel in Down and in Home position.

   Provide this data in pre-ATP report.

4.7 Smart Arm Data

1. Report smart arm data for all pedestal positions at load and unload housings. This shall include all runout data and adjustment (teaching) data for both smart arms.

   Provide this data in pre-ATP report.

4.8 Cooling Water Flow

1. Report the actual water flow for each process station (Side A and Side B) as reported by water flow switches.

   Provide this data in pre-ATP report.

Pre-ATP Acceptance	
The customer hereby accepts completion of the pre-ATP activities outlined in this section	
Signed (VSD):	Date:
Signed (Customer):	Date:

5.0 VACUUM SYSTEM TESTING

The vacuum system is comprised of the main chamber, process chambers, load locks, associated piping and the various vacuum pumps and gauges. The purpose of testing the vacuum system is to validate its performance in creating a proper environment for disk coating processes. During all vacuum testing, all process stations will be installed and cooling supply lines pressurized to 60 psig minimum pressure. Some of these tests are to be repeated after installation of the system at the customer's site, as noted in the appropriate section.

Note: **The following vacuum tests must be performed in the sequence listed in this document. Do not start a test until the previous one has been completed!**

5.1 Ultimate Pressure Tests

The main chamber, process chambers, load locks, and buffer lock will all be valved for high vacuum pumping. The carousel will be up. The ion gauges in the main chamber and buffer lock measure the ultimate pressure under these conditions.

No time limit is imposed on this test, but ultimate pressure is expected to occur within one to three days. The exact time is dependent on the length of time the system has been at at atmospheric pressure, the relative humidity of the atmosphere, and amount of time already spent at high vacuum.

Main Chamber Ultimate Pressure Test	
Test Criterion: Ultimate Pressure = 2.0×10^{-7} torr or less	
Actual Value (torr):	
Signed (VSD):	Date:
Signed (Customer):	Date:

Buffer Lock Ultimate Pressure Test	
Test Criterion: Ultimate Pressure = 5.0×10^{-7} torr or less	
Actual Value (torr):	
Signed (VSD):	Date:
Signed (Customer):	Date:

Note: **Ultimate Pressure Tests are to be repeated after installation at customer site.**

5.2 Process Chamber Pressure Test

After 2.0×10^{-7} torr pressure has been reached in the main chamber with the carousel raised, the carousel is lowered. After a 5-minute stabilization period, the resultant main chamber ion gauge pressure is noted.

Process Chamber Pressure Test	
Criteria: With carousel down, pressure to be 5.0×10^{-7} torr or less	
Carousel Position: Down	**Pressure (torr):**
Signed (VSD):	Date:
Signed (Customer):	Date:

Note: Process Chamber Pressure Test is to be repeated after installation at customer site.

5.3 Rate of Rise Testing

To provide a reference performance for the vacuum system, rate of rise measurements will be made. These are conducted by shutting off the appropriate cryovalves and monitoring the pressure rise with time. The pressures at two points in time are subtracted to give a pressure differential in a measured time. The rates of rise in torr/second are then computed and matched against the criteria shown below. Ion gauge pressure is noted versus time, and monitoring is continued through one of the scale decades for a minimum of 15 minutes, or until pressure reaches or exceeds 1×10^{-4}. Test data shall be noted on the attached form on page 18.

Full System Rate of Rise

For full system rate of rise, the carousel is lowered and all high vacuum valves are closed to start the test.

Full System Rate of Rise	
Test Criterion: Rate of rise to be 2.0×10^{-7} torr/second or less	
Actual value (torr/second):	
Signed (VSD):	Date:
Signed (Customer):	Date:

Main Chamber and Buffer Lock Rate of Rise

For main chamber and buffer lock rate of rise, the system is pumped to high vacuum again. Then the carousel is raised and all high vacuum valves are closed.

Main Chamber Rate of Rise	
Test Criterion: Rate of rise to be 2.0×10^{-7} torr/second or less	
Actual value (torr/second):	
Signed (VSD):	Date:
Signed (Customer):	Date:

Buffer Lock Rate of Rise	
Test Criterion: Rate of rise to be 5.0×10^{-7} torr/second or less	
Actual value (torr/second):	
Signed (VSD):	Date:
Signed (Customer):	Date:

5.4 System Pumpdown Testing

The carousel is lowered, all high vacuum valves are closed, and the system is vented using clean, dry nitrogen. The system is allowed to stand for five minutes at atmospheric pressure of nitrogen. The start time is noted and pumpdown is initiated. When crossover pressure is reached, all the high vacuum valves are opened, the carousel is raised. Pressures and time are recorded on the attached form on page 19.

System Pumpdown Testing	
Test Criterion: Pumpdown to 3.0×10^{-7}torr to be 1 hour or less	
Crossover Time (minutes):	
Chamber Pressure, TC-1 (millitorr):	
Actual time to 3.0×10^{-7} torr (hours):	
Signed (VSD):	Date:
Signed (Customer):	Date:

5.5 Optional Pump Down Testing

The carousel is lowered, all high vacuum valves are closed, and the system is vented using clean, dry nitrogen. The system is allowed to stand for one hour at atmospheric pressure of nitrogen. The start time is noted and pumpdown is initiated. When crossover pressure is reached, all the high vacuum valves are opened, the carousel is raised, and the load gate is closed. Pressures and time are recorded on the attached forms.

Main Chamber Pumpdown Testing	
Crossover Time (minutes):	
Chamber Pressure, TC-1 (millitorr):	
Actual time to 3.0×10^{-7} torr (hours):	
Signed (VSD):	Date:

Signed (Customer):	Date:
Buffer Lock Pumpdown Testing	
Crossover Time (minutes):	
Chamber Pressure, TC-1 (millitorr):	
Actual time to 6.0×10^{-7} torr (hours):	
Signed (VSD):	Date:
Signed (Customer):	Date:

6.0 DISK TRANSPORT AND PROCESS TEST CONDITIONS

The full system is exercised to demonstrate proper operation of all process stations and reliability of the disk transport mechanisms.

Overall, the test requires approximately four hours of disk transport operation for each disk size with periods of heat-only and full-process coating run at defined intervals.

6.1 General Test Conditions

The main chamber base pressure will be 2.0 x 10^{-7} torr or lower prior to the start of full-process testing. For disk transport and heat-only testing, this base pressure criteria may be excepted.

6.2 Substrate Materials

All substrate materials are to be provided by the customer, unless otherwise agreed upon with INTEVAC. For heat-only process and disk transport testing, a clean, uncoated set of disks will be recycled after sufficient cooling as described in later sections. For full-process testing, only fresh, clean, uncoated disks will be used.

6.3 Sputtering Targets

Sputtering targets for mounting in the sources are to be supplied by the customer approximately three weeks prior to testing. In the event that problems related to the targets are experienced, VSD and the customer will mutually investigate to determine the cause. VSD reserves the right to install its own targets in order to satisfy the test requirements, should that prove necessary.

If targets are not supplied by the customer in the time frame specified above, VSD reserves the right to utilize VSD-provided SS304 targets for said testing.

6.4 Additional Materials Required

A minimum of six cassettes for each disk size are provided by NSG.

6.5 Heat Process Conditions

Heat-only process (using the infrared heater station) is employed to stress the system during extended disk transport testing.

Before the disks are recycled through the system, each cassette of heated disks must be cooled to a maximum temperature of 30°C.

For aluminum disks a maximum temperature of 300°C will be demonstrated. For glass disks, the maximum temperature will be 350°C. System settings will be based on disk size and throughput of system under test.

6.6 General Process Conditions

Intevac has established a general process condition set for each process station based on the system configuration, disk material and size. These conditions are outlined below (at a throughput of 450 disks per hour, and a process time of 5.5 seconds).

Note: Disk diameter is 65mm and disk thickness is 0.025".

STATION (CM Chrome)		NOTES
Film thickness	200 Å	Assume 75 Å/kW-s Dep rate
Process time	4.0 seconds	
Process delay	0.3 seconds	
Process pumpout	1.2 seconds	
Coil current	2.5 amps	
Power setpoint	0.67 kW	
Substrate bias	0 v	
Argon flow	20 sccm	Par = 6 mTorr
Target voltage	350 v	
Result	200 Å Cr	

STATIONS 2 and 7 (IR Heaters)		NOTES
Delta temperature	+ 180° C	Assume 19.9° C/kW-s heat rate
Process time	5.5 seconds	
Process delay	0 seconds	
Power setpoint	1.64 kW	
Result (after Heater 2)	380° C	

STATION 4 (CM Chrome)		NOTES
Film thickness	200 Å	Deposition rate will depend on material being deposited
Process time	4.0 seconds	
Process delay	0.3 seconds	
Process pumpout	1.2 seconds	
Coil current	2.5 amps	
Power setpoint	0.30 kW	
Substrate bias	0 v	
Argon flow	20 sccm	Par = 6 mTorr

STATIONS 3, 5, 6 (CM Chr m)		NOTES
Film thickness	200 Å	Deposition rate will depend on material being deposited
Process time	4.0 seconds	
Process delay	0.3 seconds	
Process pumpout	1.2 seconds	
Coil current	2.5 amps	
Power setpoint	0.67 kW	
Substrate bias	0 v	
Argon flow	20 sccm	Par = 6 mTorr

STATION 8 (RM Chrome)		NOTES
Film thickness	200.0 Å	Assume 55 Å/kW-s Dep rate
Process time	4.0 seconds	
Process delay	0.3 seconds	
Process pumpout	1.2 seconds	
Z-position	.100	
Power setpoint	0.9 kW	
Argon Pressure	5.0 mTorr	Par = 6 mTorr
Target voltage	~500 v	
Result	200 Å Carbon	

STATION 9 (CM Magnetic)		NOTES
Film thickness	250 Å	Assume 90 Å/kW-s Dep rate
Process time	4.0 seconds	
Process delay	0.3 seconds	
Process pumpout	1.2 seconds	
Coil current	2.5 amps	
Power setpoint	0.69 kW	
Substrate bias	0 v	
Argon flow	15 sccm	Par = 6 mTorr
Target voltage	350 v	
Result	100 G-um	

STATIONS 10, 11, 12 (RM Carbon)		NOTES
Film thickness	50.0 Å	Assume 12 Å/kW-s Dep rate
Process time	3.0 seconds	Pumpout = 2.2 seconds
Process delay	0.3 seconds	
Z-position	0.075-0.1	
Power setpoint	1.35 kW	
Argon/H2 flow	15/8 sccm	Par = 6 mTorr
Target voltage	550 v	
Combined result	150 Å Carbon	

7.0 TESTING OF DISK TRANSPORT AND PROCESS SYSTEMS

Using the conditions described in Section 6.0 and the schedule outlined below, the MDP-250B is tested for full functioning of all process subsystems while the disk transport system is being tested.

7.1 Test Criteria

The MDP-250B system must run 1200 cycles without dropping a disk within the system or otherwise having an abort. (If an abort is caused by an NSG cassette or disk problem, the criteria will be revised by mutual agreement between NSG and Intevac.) With the exception of full process intervals, this testing will occur at a throughput agreed upon by NSG and Intevac.

7.2 Process Run - 1000 disks

One thousand (1,000) new substrates are used for full process testing. These disks may be identified only by cassette number (as they cannot be marked in any fashion) and loaded into their own cassettes. After coating, these disks will be given to the customer. Since the coating processes consume targets and substrates, full-process testing is performed only at periodic intervals to verify full functionality of all process subsystems throughout the testing process.

Two disks will be removed from this run and measured for coercivity and Mrt.

1000 Disk Run Completed	
Signed (VSD):	Date:
Signed (Customer):	Date:

7.3 Heat Only Run - 10,000 disks

The system shall be operated for 10,000 continuous cycles using the heating condition specified in Section 6.

Uncoated, recycled disks are used for testing the heat-only process. As cassettes are filled during the heat processing operation, they must be removed from the unload conveyor, the disks they contain cooled to below 30°C, and then reinstalled on the load conveyor.

10,000 Disk Heat Run Completed	
Signed (VSD):	Date:
Signed (Customer):	Date:

7.4 Film Thickness Uniformity Measurement

The deposition rate for each station is calculated as follows:

$$\text{Deposition rate constant} = \frac{\text{Average thickness}}{\text{Deposition time x Power}} = \frac{\text{Å}}{\text{sec x kw}}$$

1. Coat one disk in each chromium deposition station with approximately 500 Å total thickness.
2. Coat one disk in each magnetic alloy deposition station with approximately 750 Å magnetic alloy.
3. Coat one disk in all three carbon stations with approximately 150 Å carbon.
4. Use X-ray flourescence spectroscopy for chromium and magnetic films and n&k for carbon films. Measure film thickness at the following points on the disks:

Measurement Locations			
Diameter: 65mm			
Quadrant Angle	**Radius** 12mm	22mm	32mm
0°			
90°			
180°			
270°			
Note: Total number of measuring points per side is 12. Total number of points per disk is 24.			

Calculate film thickness uniformity as follows:

$$\delta\% = \frac{T_{max.} - T_{min.}}{T_{max.} + T_{min.}}$$

Disk performance is to be tested by the customer on an expedited basis to verify the following characteristics:

Thickness uniformity Variation (CM stations): Less than ± 6% for chrome, less than ± 5% for magnetic alloys, and less than ± 10% for carbon

Thickness uniformity Variation (RM stations): Less than ± 4% for chrome and magnetic alloys and less than ± 5% for carbon

Film Thickness Uniformity Acceptance	
All sample data to be attached.	
Signed (VSD):	Date:

Signed (Customer):	Date:

Vacuum Systems Division	RATE OF RISE TESTS	Mod l:
		S rial Number:
Conditions:		Date:
Base Pressure:		Test by:

TIME min:sec-ond	PRES-SURE torr	REMARKS
0:00		All high vacuum valves closed: test started

Vacuum Systems Division	PUMPDOWN TESTS	Mod I:
		Serial Number:
Conditions:		Date:
Base Pressure:		Test by:

TIME min:second	PRESSURE torr	REMARKS
0:00		Rough valve opened; test started